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Information

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How to Read a Material Safety Data Sheet

Pesticide Information Leaflet No. 29

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Background

The Material Safety Data Sheet (MSDS) can be a very useful document to learn about a specific chemical such as a pesticide (herbicide, insecticide, fungicide, rodenticide, disinfectants, etc.) or other potentially hazardous substance. Manufacturers of these substances are required to develop, and to provide upon request, a MSDS for each product. The MSDS provides information about the product's composition, physical and chemical properties and hazards, toxicological information, and first aid procedures. Commercial establishments using pesticides and other products are required to keep MSDS and make them available to workers or others potentially exposed to the substance, its diluted end product, or its residues. Because there is no standardized form for the MSDS, and because the information is presented in technical terms, it can be difficult for readers without specialized scientific training to decipher the MSDS. This leaflet explains how the MSDS is derived and arranged, and helps the reader interpret the information contained in the MSDS.

Ideally, the MSDS is used in combination with reading the pesticide label. See Pesticide Information Leaflet No. 28, *How to Read a Pesticide Label* for important information on this topic.

Development of the MSDS

Pesticide manufacturers must perform a wide range of tests before their products can be registered with the U.S. Environmental Protection Agency (EPA) for use in the United States. MSDS reflect the results of these tests on the formulated product. However, most commercial pesticides and some homeowner products need to be diluted (usually with water or a horticultural oil) before they are applied. In such cases, the mixtures applied are much less concentrated than the original products. In the case of liquids, once they have dried on the application site, residues are much less

available for transfer to humans, pets, other animals, etc. Residues of both liquid and dry materials degrade over time. One of the most basic concepts of toxicology is the dose-response relationship. That is, for most effects, the lower the dosage one is exposed to, the lower the likelihood of experiencing any adverse effects.

The Hazard Communication Standard of the Occupational Safety and Health Act (OSHA) requires the MSDS to be made available to workers in manufacturing or to any end-user who handles the end-use formulated material. MSDS readers should remember that, other than applicators, people are usually exposed to diluted products or to residues rather than to the product for which the MSDS was developed. Incidental exposure from dilute sprays does not equate to work place exposure information presented in the MSDS, and the information should be interpreted with this in mind.

Components of the MSDS

The information contained in the MSDS may appear under different headings and do not have to follow the same order, but the elements of the MSDS are the same.

Chemical product identification

This section identifies the ingredients in the product by common (generic) name and percentage of the *active ingredient(s)* and by percentage of *inert ingredients*. An inert ingredient is simply one for which no toxic activity against the pest is claimed, while the active ingredient is that component that actually control the pest. Inert ingredients, however, may have effects on humans or other animals, plants, etc. The exact identification of inert ingredients is considered proprietary information and thus is not required to be listed on either a label or the MSDS. However, EPA maintains a list of inert ingredients, considered not to present excess hazards, from which registrants choose when they formulate products. This section of the MSDS may also provide information about the class of chemical, such as "organophosphate insecticide" or "chlorophenoxy herbicide." Because chemicals in a particular class share certain characteristics, this information may be helpful, particularly to the health care professional. This section also often provides synonyms, *i.e.*, brand names of other products with the same composition.

Physical and chemical properties

This section describes the product's physical appearance and provides information about how the product behaves under certain physical and chemical conditions. Particularly relevant are the measures for solubility in water, vapor pressure, stability, and melting/freezing point.

Water solubility is a factor in whether a substance is likely to be carried off site in run-off water or in leachate. In general, the lower the solubility, the more likely the substance is to bind to soil particles or organic matter rather than to dissolve in water. A relatively high solubility in water can be a benefit, however, since products that are water soluble will be excreted in the urine rather than stored in the fat.

A substance's *vapor pressure* helps determine whether the substance is likely to

volatilize, or form a gas. Other factors involved include temperature; how tightly the substance binds to soil particles, plants, or the site of application; and how much water is present (combined with the substance's water solubility). Products with relatively high volatility are more likely to be detected through smell than products with low volatility. Some MSDS provide direct information about the odor of a product, which may range from practically odorless to very apparent.

Stability and *boiling and freezing points* of a substance determine whether a product can be stored over the summer or winter. Freezing and excessive heating may degrade the product, resulting in a loss of efficacy against the pest.

Fire and explosion hazards

Some substances can spontaneously catch on fire at a certain temperature. In such cases, the MSDS will identify the temperature, called the *flash point*, at which the substance catches fire. The MSDS may list conditions to avoid, such as materials which are incompatible with the product. For instance, some substances can react with galvanized containers to form hydrogen gas, a highly combustible material.

Toxicological information / Human health data

The MSDS identifies by what route(s) of exposure (*ingestion*, or through the mouth; *dermal*, or through the skin; and *inhalation*, or by breathing the product's vapors) the product may be harmful. The MSDS also summarizes results of toxicological tests performed on laboratory animals and extrapolates them to potential for effects on humans. The toxicological tests required by EPA include *acute toxicity* (effects from a single exposure, apparent within 24 - 48 hours after exposure), *chronic or delayed toxicity* (effects from repeated exposure over time, which may not be apparent for weeks to many years after exposure), *oncogenicity* (ability to cause tumors), *carcinogenicity* (ability to cause malignant tumors, or cancer), *teratogenicity* (ability to cause birth defects), and *fetotoxicity* (other adverse effects on the fetus, such as low birth weight or spontaneous abortion). Symptoms of acute overexposure are usually identified by the MSDS. The MSDS also lists medical conditions that may be aggravated by exposure to the product.

Acute toxicity by oral or dermal exposure is provided in terms of the LD_{50}, or Lethal Dose 50%. The LD_{50} equals the dosage at which 50% of the test animals died as a result of the exposure. Inhalation toxicity is provided in a similar term, the LC_{50}, or Lethal Concentration 50%. Because the lethal dose varies with the body weight of the animal (or human), the LD_{50} value is expressed as milligrams of active ingredient per kilograms of body weight (mg/kg). Similarly, the LC_{50} is expressed as milligrams of active ingredient per liter of air (mg/L). Note that there is an inverse relationship between the LD_{50} or LC_{50} value; *i.e.*, the smaller the value, the more toxic the substance. The LD_{50} and LC_{50} are best used to compare the acute toxicity of one product to another. EPA categorizes pesticides' acute toxicity as follows:

Acute Toxicity Category	LD_{50}	Amount estimated to cause death in adult human
I. extremely toxic	less than 50	a few drops to a teaspoon
II. moderately toxic	50 to 500	over 1 teaspoon to 1 ounce
III. slightly toxic to relatively nontoxic	more than 500	more than 1 ounce

It is important to remember that the substance's level of acute toxicity is not related to the substance's ability to cause chronic or delayed effects. The MSDS usually provides specific information about the product's ability to cause eye and skin irritation or allergic responses. Allergic responses are also not related to the chemical's level of acute toxicity. Thus, it is possible for a Category III pesticide to be associated with adverse long-term effects or allergic reactions and, conversely, for a Category I pesticide to have no known long-term or allergic effects.

Cholinesterase inhibition

If the pesticide can bind to cholinesterase, an enzyme necessary for proper nervous system transmission, the MSDS may identify it as a cholinesterase inhibitor. Such identification was not required until recently. See *Pesticide Information Leaflet No 7: Cholinesterase Testing* or *No. 30: Cholinesterase Monitoring: A Guide for the Health Professional* for more information on this subject.

Regulatory levels and classifications

Some compounds have had regulatory limits set on the amount of time a worker can be exposed to them. Some substances have been classified with regard to their ability to act as carcinogens (cancer-producing substances). Some of the terms used can be confusing, as they sound similar but have been set by different agencies for subtly different situations. Terms used on the MSDS may include the following:

- Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV). The TLV is an 8-hour time-weighted average exposure that should not be exceeded. The TLV is given in parts per million (ppm) or in milligrams per cubic meter (mg/m^3).
- Occupational Safety and Health Administration(OSHA) Permissible Exposure Limit (PEL). The PEL is a time-weighted average concentration that must not be exceeded during any 8-hour work shift of a 40-hour work week. PEL concentrations are given in the same units (ppm or mg/m^3) as the TLV.
- Carcinogen classification. EPA and other agencies use a classification system to rate the human carcinogenic potential of compounds. The levels of carcinogenicity under this system are known (Group A), probable (Group B), and possible (Group C) human carcinogens. Probable human carcinogens are further refined as Group B1 (probable human carcinogens with limited human evidence) or B2 (probable human carcinogens with sufficient evidence in animals but inadequate or no evidence in humans).

Personal protection recommendations

Special equipment to be worn while handling the concentrate product will be specified by the MSDS. Many products do not require special protective equipment. Others require chemical-proof gloves, goggles, respirators, or other gear. Remember that the equipment listed pertains to the product as formulated. Refer to the pesticide label to check whether gear listed on the MSDS is required to be worn while handling the diluted product.

Emergency and first aid procedures

The MSDS provides specific information about first aid and emergency treatment for the product. If the chemical is a cholinesterase inhibitor, the MSDS will so state, and treatment information for the physician will be provided. (See *Pesticide Information Leaflet No. &: Cholinesterase Testing*, for more information on cholinesterase inhibitors.)

Ecological or environmental hazards

EPA requires toxicological testing on indicator species of plants and animals. The MSDS provides information on acute and chronic effects on wildlife in similar terms as that pertaining to humans.

Spills, fires, and accident procedures

The MSDS contains directions for cleaning up spills and leaks, as well as special information for fire fighters.

Storage and disposal

These directions may range from very specific to quite general.